

WHAT IS CLAIMED IS:

1. A sensor comprising:

- (a) a substrate;
- 5 (b) at least one pair of electrodes;
- (c) an encapsulating matrix comprising;
- (d) at least one enzyme;
- (e) at least one reactant; and
- (f) at least one transducer material.

10

2. The sensor of claim 1, wherein said substrate is selected from the group consisting of glass, ceramic, and plastic.

15 3. The sensor of claim 1, wherein said electrodes comprise one or more elements selected from the group consisting of gold, platinum, or silver.

4. The sensor of claim 1, wherein said electrodes are interdigitated.

20

5. The sensor of claim 1, wherein said sol gel matrix covers the substrate and the electrodes.

25 6. The sensor of claim 1, wherein said encapsulating matrix is a sol gel, said sol gel matrix comprising at least one organosilane, which may be tetrafunctional, like tetramethoxy orthosilicate, trifunctional, like methyltrimethoxysilane, octadecyltrichlorosilane, octadecyltriethoxysilane,

phenyltrimethoxysilane and 1,4-bis(trimethoxysilyl)benzene,  
or difunctional, like methyldimethoxysilane,  
dimethyldiethoxysilane, or monofunctional, like  
octadecyldimethylmethoxysilane, or derivatized silanes, like 2-  
5 (3,4-epoxycyclohexyl)ethyltrimethoxysilane, 3-  
aminopropyltrimethoxysilyane, 4-aminobutyldimethoxysilane, N-(2-  
aminoethyl)-3-aminopropylmethyldimethoxysilane, 5-  
(bicycloheptenyl)triethoxysilane, dicyclohexyldimethoxysilane  
and 3-glycidylpropyltrimethoxysilane.

10

7. The sensor of claim 1, wherein said encapsulating matrix  
encapsulates said enzyme.

8. The sensor of claim 8, wherein said enzyme may be one  
15 selected from the group consisting of tryptophanase, gelatinase,  
 $\beta$ -lactamase, catalase, casease, citrase, decarboxylase,  
deoxyribonuclease, lipase, nitrate reductase,  $\beta$ -galactosidase,  
cytochrome oxidase, phenylalanine deaminase, 1-pyrrolidonyl  
arylamidase, cystein desulfase, urease, L-asparaginase,  
20 glutamate dehydrogenase, organophosphorus hydrolase,  
acetylcholinesterase,  $\alpha$ -amylase and is preferably glucose  
oxidase.

9. The sensor of claim 1, wherein said transducer material and  
25 said reactant are dispersed in said encapsulating matrix.

10. The sensor of claim 1, wherein said reactant is starch  
containing amylose.

11. The sensor of claim 1, wherein said transducer material is  
a polymer.

12. The sensor of claim 11, wherein said polymer is a water  
5 soluble polymer.

13. The sensor of claim 12, wherein said water-soluble polymer  
is selected from the group consisting of polyaniline,  
polythiophenes, polyacetylenes, polypyrroles, and combinations  
10 thereof.

14. A method for the detection of organisms by a sensor, the  
sensor comprising a substrate; at least one electrode; a sol gel  
matrix comprising; at least one enzyme; at least one reactant;  
15 and at least one transducer material; wherein

- (a) an organism expresses an enzyme on the surface of the  
sensor;
- (b) the enzyme causes a reaction with the reactant of the  
sensor;
- 20 (c) the product according to process step (b) reacts  
further as catalyzed by said enzyme of the sensor;
- (d) the products of process step (c) modulate at least one  
property of the transducer material;
- (e) the modulated property is measured.

25

15. The method according to claim 14, wherein the expressed  
enzyme is selected from the group consisting of tryptophanase,  
gelatinase,  $\beta$ -lactamase, catalase, casease, citrase,

decarboxylase, deoxyribonuclease, lipase, nitrate reductase,  $\beta$ -galactosidase, cytochrome oxidase, phenylalanine deaminase, L-pyrrolidonyl arylamidase, cystein desulfase, urease, L-asparaginase, glutamate dehydrogenase, organophosphorus  
5 hydrolase, acetylcholinesterase, and  $\alpha$ -amylase.

16. The method of claim 14, wherein said product of process  
step (c) is selected from the group consisting of lactic acid,  
carbon dioxide, hydrogen, ethanol, acetic acid, succinic acid,  
10 gluconic acid, and formic acid.

17. The method according to claim 14, wherein  
(a) an organism expresses  $\alpha$ -amylase;  
(b)  $\alpha$ -amylase catalyzes the hydrolysis of starch to form  
15 glucose;  
(c) glucose oxidation is catalyzed by glucose oxidase to  
form gluconic acid and  $H_2O_2$ ;  
(d) gluconic acid and  $H_2O_2$  modulate the electrical  
resistance of an inherently conductive polymer, or  
20 transducer material;  
(e) the modulated electrical resistance of the inherently  
conductive polymer, or transducer material is measured  
with a voltage source and ohmmeter.